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ENVIRONMENTAL ASSESSMENT

POTENTIAL UPGRADE OF THE TENASKA SITE FOR ESTABLISHING A SIMPLE-CYCLE OR COMBINED-CYCLE ELECTRIC GENERATION FACILITY

Haywood County, Tennessee

TENNESSEE VALLEY AUTHORITY

MARCH 2007

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THE PROPOSED DECISION AND NEED

TVA has an opportunity to purchase a combustion turbine (CT) site formerly known as the Tenaska Brownsville site (Figure 1), which is adjacent to TVA's existing Lagoon Creek simple-cycle peaking plant in West Tennessee near Brownsville in Haywood County. The Tenaska Brownsville site was originally constructed and permitted for three simple-cycle CTs with the intention of expanding to combined-cycle (CC) operation in the future. TVA is proposing to use the site for a similar purpose. The CC plant configuration is projected to be operated 25-40 percent of the time at intermediate capacity; alternatively completion of the simple-cycle system could add more peaking capacity to TVA's system. This site has gas line connections and a 500-kilowatt transmission line that runs through the property. The site also has two wells with a rated capacity of 1000 gallons per minute (gpm).

The site was designed for three simple-cycle combustion turbines. The project was cancelled prior to commercial operation due to the absence of a purchase power agreement and the decline in demand for retail power. The engines were never connected to either the electric or natural gas transmission systems. The original combustion turbines have been sold and are in the process of being removed from the site. TVA is now considering purchasing Mitsubishi Heavy Industry (MHI) combustion turbines that will fit the existing foundation pads.

TVA is evaluating five options for upgrading electrical generation capacity at the former Tenaska Brownsville site. The options range from adding 360 megawatts (MW) of simple-cycle capacity to construction of an approximately 900 MW combined-cycle facility. Option specifics are provided in the Alternatives and Comparison section.

The demand for electrical power in the TVA service area has been growing at an annualized rate of approximately 2 percent over the last decade. Projection studies covering the next two decades indicate a similar rate of growth. This growth equates to approximately 600 MW of capacity per year based upon a TVA service area 2006 demand exceeding 32,000 MW. Additionally, regional reliability standards submitted to the Federal Energy Regulatory Commission ("FERC") by the North American Electric Reliability Council ("NERC") in compliance with the *Energy Policy Act of 2005* require electrical generation service companies to acquire and retain an increased percentage of reserve generation capacity. NERC standards also require firm capacity for Disturbance Control Standard (DCS) recovery events. Non-firm market purchases cannot be used to fulfill either reserve capacity requirement. Cumulatively, TVA must acquire approximately 3,700 MW of peaking and intermediate generation capacity over the next four years to meet these requirements exclusive of firm power purchase agreements. In reflection of at the volatility and scarcity of the equipment market, an expeditious decision timetable is necessary. This EA is critical to that decision profile.

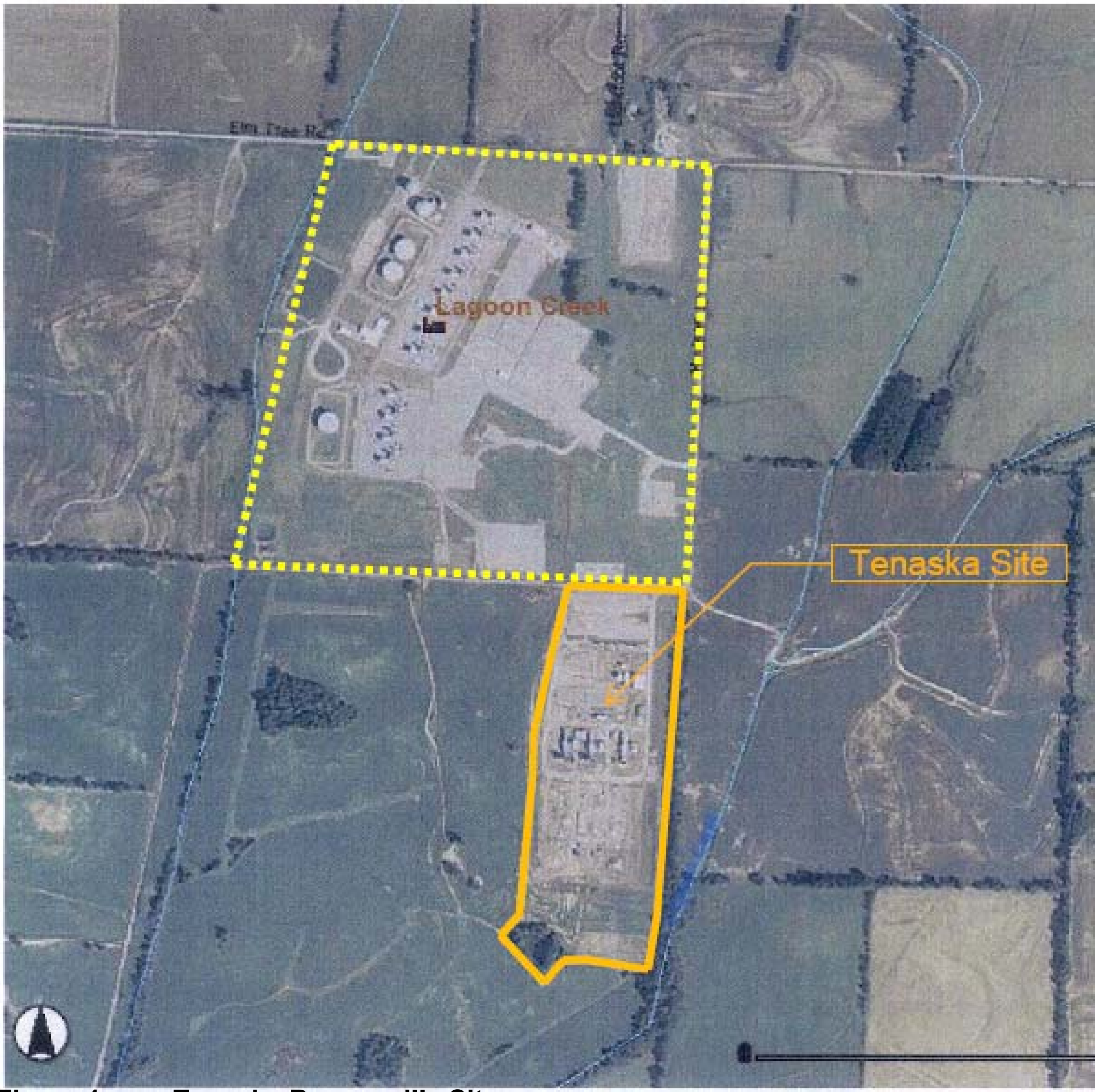


Figure 1. Tenaska Brownsville Site

BACKGROUND

CT/CC CHARACTERISTICS

TVA is investigating the use of CT/CC to address growing demand and expanded regulatory standards.

> ”Growing demand for electricity in the United States has absorbed surplus generating capacity in many regions in the country and is causing an increase in demand for new generating capacity to avoid system failures and price spikes. Due to improvements in technology and deregulation of much of the gas and electric markets, utility and non-utility generators alike are installing CT/CC as a cost-effective method to incrementally meet their growing needs for peaking capacity.” (RUS 2000)

CTs are internal combustion engines that operate with a rotary rather than reciprocating motion. CTs are used in a broad scope of applications including electric power generators and in various process industries. Electric utilities use CTs primarily as peaking generation capacity to meet short-term power demand peaks. Individual units range in size from 15 MW to over 200 MW, with an average size of 45 MW. Owing to their modular nature, CTs can be installed as a single unit or group of units sequentially to meet power demand. The versatility to install capacity incrementally to align supply with demand is a highly desirable attribute from both economic and operational perspectives.

Environmentally, current models of CTs are generally lower emitters of contaminants than traditional generating sources due to the utilization of natural gas as the primary fuel source. On-site liquid distillate (No. 2 fuel oil) serves as a backup fuel source which provides additional operational assurance for emergency demand requirements and interruptions in natural gas supply. By design, CTs do not run continuously, but rather are cycled on- and offline to meet power system demands. By operating in this mode and with a lower emissions rate, the total emissions are substantially less than alternative technology burning coal or oil technology, which remain online for extended periods regardless of load demands.

A CT consists of three major components: compressor, combustor, and power turbine. Ambient air is drawn in and compressed up to 30 times ambient pressure and directed to the combustor section where fuel is introduced, ignited, and burned. Hot combustion gases are diluted with additional air from the compressor section and directed to the turbine section at temperatures up to 2,550 degrees Fahrenheit (°F). Energy from the hot, expanding exhaust gases is then recovered in the form of shaft horsepower, of which more than 60 percent is required to power the internal compressor with the balance directed to coupled load (generator).

The heat content of the gases exiting the turbine can either be discarded without heat recovery (simple or Brayton Thermodynamic cycle) or recovered in a steam generator, with or without supplementary firing, to generate steam for a steam turbine driven generator (combined-cycle - Brayton and Rankene Thermodynamic cycles).

Simple-cycle CTs have relatively smaller capital construction costs as compared to other electrical generation technologies. They are available in standard sizes that can closely match capacity requirements as single units. Multiple units of the same or similar size can be grouped to meet larger capacity requirements or added later as capacity requirements evolve. Because most of the components are assembled as modules, onsite installation time is minimal. Siting is likewise less complicated due to both small size and absence of extensive support facilities.

The footprint of an actual three-unit (434 MW total capacity) project is only 24 acres. Major components other than the combustion turbine itself include: step-up electrical transformers, demineralized water storage tanks, raw water and fuel oil storage tanks, a water neutralization storage basin (combined cycle), and a transmission substation.

The primary criteria for siting CTs are proximity to a major gas transmission pipeline, adequate electrical transmission facilities, and roads/railroad for access and delivery of materials. Water requirements normally can be supplied either from a groundwater source or from a municipal/rural water system. Combined-cycle units will require water for steam system supplement and cooling tower evaporation replacement (makeup). Due to size and installation versatility, CTs can often be located in a manner to support existing transmission system needs thereby reducing transmission system upgrades that would otherwise be necessary to connect isolated new sites.

With rapid start capability when operating in simple cycle, combustion turbines can move from cold standby to full load in approximately 11 minutes. As such, simple-cycle combustion turbines have become the primary worldwide source for peaking capacity. By their engineering and economic characteristics, peaking units are designed to be cycled on and off with the ebbs and flows of peak electricity demand. Thus, they necessarily run less frequently than intermediate units run and consequently produce fewer emissions

While not designed for peaking application, combined-cycle installations have the capability to meet intermediate service duty. With a starting cycle of one to three hours (dependent upon starting temperature conditions), combined-cycle units can be cycled daily to meet load demands typically extending across business hours (eight hours plus). Using heat generated from a simple-cycle combustion turbine, typically 800 to 1150 degrees F, steam is generated in a “heat recovery steam generator” which, in-turn, drives a steam turbine generator unit. With approximately 55 percent more electrical power generated from the waste heat, CCs reach efficiencies of approximately 57 percent versus 35 percent in simple cycle. CCs units do require access to larger volumes of water. Typically, water intake structures in nearby surface water bodies or wells bored into ground water aquifers provides this water access. Water discharge structures, possibly with cooling towers, are also required to support CC operation.

OTHER ENVIRONMENTAL REVIEWS AND DOCUMENTATION

Generic Environmental Assessment (EA) for the Purchase of Additional Combustion Turbine Capacity: TVA recently completed a generic EA in September of 2006. The following table is provided as guidance for the application of the generic EA to proposals to purchase specific CT/CC plants. NEPA applies to proposed federal actions that would result in additional physical impacts to the environment. An action that merely continues the environmental status quo is not subject to NEPA. Acquiring and continuing to operate an existing, operating CT/CC plant would be the latter kind of action, and a NEPA review is not required to acquire this kind of plant. Existing CT/CC plants that are being considered for purchase should be placed in one of the following classes.

Table 1. Applicability of Generic Environmental Assessment to Proposals to Purchase

Combustion Turbines		
Class	**Plant Characteristics**	**NEPA Status**
1	The plant is currently operating or has operated within the last two years, and necessary environmental permits to operate the plant remain effective.	NEPA does not apply
2	The plant has been mothballed for longer than two years and/or necessary environmental permits to operate the plant have been allowed to lapse. However, the plant has not been permanently shut down, and operation in the future is expected. Indicia suggesting this include, but are not limited to, (1) statements of the current owners that shutdown is not permanent, (2) continued maintenance of equipment, (3) minimal cost to bring the plant back into operation, and (4) minimal time is needed to restart the plant.	NEPA does not apply
3	The plant does not fall within Class 1 or 2.	NEPA applies

The Generic EA would apply to almost all of the plants that may fall within Class 3. If a specific plant has unusual operating characteristics or unusual impacts on sensitive resources, additional environmental review is conducted before acquiring and operating such a plant.

The purchase of the Tenaska site falls into Class 3 and additional NEPA analysis is required prior to the purchase of this site for establishing a simple-cycle or combined-cycle electric generation facility. The preparation of this EA constitutes that additional analysis.

Lagoon Creek Final Environmental Impact Statement: In March 2000, TVA completed a Final Environmental Impact Assessment (FEIS) and a Record of Decision (ROD) for the construction of the Lagoon Creek CT site. Alternatives in this EIS ranged from the No Action to three options under the Action Alternative. The three options were construction up to 700 MW or 1,400 MW of peaking capacity or up to 1,700 MW peaking and baseload capacity (see Table 2). Three sites were considered, Lagoon Creek, Nutbush, and Tibbs, all in Haywood County, Tennessee. TVA chose as its preferred alternative the option of constructing 12 simple-cycle CTs with 1,400 MW of peaking capacity at the Lagoon Creek site. However, this EIS also addressed the addition of 1,000 MW of CC capacity.

Table 2. Plant Configurations Assessed in the Haywood County FEIS

	Haywood County FEIS Plant Configuration		
	1	2	3
Type of Generation	Peaking	Peaking	Peaking and Baseload
Type of Operation	Simple-Cycle	Simple-Cycle	Simple-Cycle and Combined Cycle
Service Mode	< 30 percent of year	< 30 percent of year	< 30 percent of year for Peaking and 100 percent for Baseload
Electricity Generated (MW)	700	1,400	1,700 (700 Peaking and 1,000 Baseload)

In conducting the analysis in this EA, the analysis in the Lagoon Creek NEPA review been taken further supplemented by focusing on impacts to the following resources: Air, Ground Water, Surface Water, Noise, and Cultural Resources. This additional focus was deemed necessary in light of the proposal to acquire and use the adjacent Tenaska site. The remainder of the Lagoon Creek EIS, which is still relevant today, included analysis for Floodplains, Terrestrial Ecology, Aquatic Ecology, Threatened and Endangered Species, Wetlands, Socioeconomics, Transportation, Land Use/Soils, Visual Resources, Safety and Health, and Seismology. This analysis from the Lagoon Creek EIS is incorporated by reference in this EA.

Energy Vision 2020 Integrated Resource Plan Final Environmental Impact Statement (EIS), TVA (1995.) In Energy Vision 2020 Integrated Resource Plan Final Environmental Impact Statement (EIS), TVA (1995) identified and analyzed the environmental impacts of alternative methods for meeting the anticipated increasing demand for electricity in the TVA region between the years 1995 and 2020. Following this environmental review, TVA adopted a portfolio of actions that could be implemented to meet demand growth. CTs and CCs were among the generating methods selected for possible implementation. This review tiers from the Energy Vision 2020 EIS.

As a federal agency, before making a decision to undertake an action with physical environmental impacts, TVA must complete an environmental review of the proposed action under the National Environmental Policy Act (NEPA). The environmental review helps TVA incorporate environmental considerations into its decision-making process. Potential impacts to the environment may be avoided or minimized through this review process. The review also helps to ensure that the proposed projects meet all applicable federal, state, and local environmental laws and regulations. Because the Tenaska site is already developed with combustion turbine foundations, control buildings, substation, and other equipment in place, and the potential off-site impacts are discussed in the previously prepared TVA FEIS TVA chose to prepare an EA to assess the site-specific impacts of reactivating the Tenaska site and the cumulative impacts of the operation of the Tenaska site when added to TVA's existing operations at the Lagoon Creek site.

ALTERNATIVES AND COMPARISON

This EA assesses the impact of the purchase and operation of an existing site developed for use of CT/CC, as well as the No Action Alternative. This proposed action falls within Class 3 of the Generic EA, described above. The No Action Alternative does not meet TVA's need for additional peaking and intermediate capacity if this facility is not purchased and re-activated, TVA would likely have to pursue greenfield construction at an increased cost and additional impact to the environment beyond re-activation of an existing vacated site with the existing infrastructure already in place.

TVA is evaluating five options for upgrading for simple or combined-cycle operations with combustion turbines at the Tenaska Brownsville Site. The options range from adding 360 MW of simple-cycle capacity to approximately 900 MW of combined-cycle capacity.

1. Purchase and installation of two Mitsubishi CTs in simple-cycle operation after modifying the "ultra low" dry low Nitrogen Oxides (NOx) combustion system to achieve less than 15 parts per million (ppm) NOx emissions. This option would have a total capacity of approximately 360 MW.

2. Purchase and installation of 3 CTs in simple-cycle operation with "ultra low" dry low NOx combustion systems. This option would have a total of approximately 540 MW capacity.

3. Purchase and installation of 2 CTs and a 250 MW General Electric (GE) D11 CT that TVA has in storage for a 2X1 combined-cycle plant. This option would have a total capacity of approximately 600 MW.

4. Purchase and installation of 3 CTs and the 400 MW Toshiba Steam Turbine purchased from Calpine in a 3X1 combined-cycle operation. This option would have a total capacity of approximately 900 MW.

5. Option 3, plus a later installation of an additional CT (to be purchased), and a 140 MW steam turbine (to be purchased), in 1X1 combined-cycle operation. This option would have a total capacity of approximately 900 MW.

The different types of CTs that could be purchased for operation under the Action Alternative include simple-cycle single fuel, simple-cycle dual fuel, or combined-cycle dual fuel. All three types of CTs would likely have similar air impacts, assuming similarity in the fuel used. However, a CC would likely operate at higher noise levels and require more ground water because of the use of cooling towers and the need for boiler make-up water. Similarly, CCs would have a slightly greater impact on water quality as a result of the discharge of heat.

The simple-cycle operations would require the addition of dry low NOx combustion controls and would use much less water than the combined-cycle operations. Combined-cycle operations would need to add Selective Catalytic Reduction (SCR) controls for NOx and potentially an oxidation catalyst to meet the New Source performance Standards (NSPS). Combustion-cycle operations would likely require a Prevention of Significant Deterioration (PSD) permit since such operation would be for intermediate capacity involving higher annual hours of operation.

AFFECTED ENVIRONMENT AND EVALUATION OF IMPACTS

IMPACTS EVALUATED

<u>Groundwater Resources</u>

Affected Environment

The principal aquifers in the project site region include, in descending order from the ground surface, the Cockfield formation, the Memphis Sand, and the Fort Pillow Sand formation. The Cockfield formation is the principal source of water in the region for domestic and farm water supplies. It consists of interbedded sand, silt, clay, and lignite of fluvial origin. The thicker and more productive sand beds are commonly found near the base of the formation. The Cockfield formation is absent in the eastern half of Haywood County, but the formation thickness exceeds 200 feet (ft) in the extreme northwestern corner of the county. Thick clay beds of the Cook Mountain Formation lie beneath the Cockfield aquifer and retard the downward movement of groundwater to underlying Memphis Sand aquifer. Wells in the Cockfield aquifer rarely exceed 350 ft in depth and most are less than 200 ft. The aquifer supports small to moderate capacity wells having yields of 5 to 300 gpm (Parks 1985).

The Memphis Sand aquifer is a major source of public and industrial water in western Tennessee. It is the source of water for all of the municipalities surrounding the proposed plant sites including Brownsville, Ripley, Covington, and Stanton. The aquifer is very productive, yielding up to 2,300 gpm to individual wells in western Tennessee. The Memphis Sand primarily consists of massive beds of fine to coarse sand with relatively few interbedded silt and clay layers. The formation ranges up to 900 ft in thickness in downdip areas in the western part of the region and is thinnest along the eastern outcrop area (Figure 3-4) of the Lagoon Creek EIS. Formation thickness in Haywood County ranges from approximately 200 ft in the southeastern corner of the county to 600 ft in the northwestern corner. The base of the Memphis Sand dips westward at rates of 20 to 50 ft per mile. The Flour Island formation is the lower confining unit for the Memphis Sand aquifer, separating it from the underlying Fort Pillow aquifer.

The Fort Pillow formation is present throughout Haywood County and most of western Tennessee. It is a potentially important aquifer in the region, but currently is not widely used because of the availability of shallower groundwater in most areas. Present use is limited to areas in and near the formation outcrop in Carroll, Hardeman, Henry, and Madison Counties, and to the Memphis area in Shelby County. The Fort Pillow is primarily composed of fine to medium sand with relatively minor amounts of interbedded silt and clay. Formation thickness generally increases from east to west across western Tennessee, with thickness ranging from about 100 ft in southeastern Haywood County to about 300 ft in the northwestern part of the county. The base of the formation dips westward at rates of 25 to 50 ft per mile (Parks and Carmichael 1989). The Fort Pillow aquifer is underlain, in turn, by the Old Breastworks, Port Creek, and Clayton formations, all of which are confining units. These confining units separate the Fort Pillow aquifer from the deeper McNairy-Nacatoch aquifer.

Pump test data from test hole #1 located at the neighboring Lagoon Creek generation facility indicate that individual well pumping rates of 1,000 gallons per minute (gpm) are probably achievable in the Memphis Sand aquifer and individual well pumping rates of 500 gpm are probably achievable in the Fort Pillow Sand aquifer.

A 1999 survey of water supply wells in the site vicinity indicated groundwater development in the site region is primarily limited to the Cockfield and Memphis Sand aquifers. The Memphis Sand aquifer is the source of water for all public and industrial supplies within 10 miles of the site, including the Brownsville and Ripley municipal supplies. Brownsville operates seven wells in and around the city, and two wells located in the Tibbs community some 9 to 10 miles northwest of the city. Total groundwater withdrawals by Brownsville in 1998 were reported to be 2.0 million gallons per day (MGD). The historical groundwater use for Brownsville and other surrounding municipalities presented in Table 3-7 of the Lagoon Creek EIS indicates regional growth in groundwater withdrawals from the Memphis aquifer of approximately 3 percent per year since 1953. The Cockfield formation is the principal source of supply for shallow residential and farm wells in the region. Of the 26 registered wells within a two-mile radius of the Lagoon Creek facility, 84 percent are completed in the Cockfield formation and 16 percent in the Memphis Sand. An additional 36 residences within the survey region in areas not served by public water are presumed to have wells.

Environmental Consequences

Excavation and grading associated with construction of the plant alternatives or any of the ancillary features, such as the pipelines, are not expected to cause adverse effects to groundwater. Being an existing facility that has established foundations for the turbines and ancillary equipment, any additional excavation and grading is expected to be minimal.

Operational impacts to groundwater are primarily related to drawdown of water levels in the Memphis Sand and adjacent aquifers resulting from plant groundwater use. Operational water requirements for each of the proposed plant configurations are summarized in Table 3. Estimates of long-term (30-year) average water demand and peak water demand during a 30-day period are provided for each alternative. Two existing water supply wells completed in the Memphis Sand aquifer and reportedly capable of providing 1000 gpm each would be utilized. Additional wells developed either in the Memphis Sand or the deeper Fort Pillow aquifer would be required to fully provide the water requirements of plant options 3 through 5. Minimum well spacings of 1000 feet would require locating the additional wells outside of the proposed plant property.

Table 3. Plant Water Requirements

Plant Design Option	Plant Capacity (MW)	Average Water Demand* (gpm)	30-Day Peak Water Demand (gpm)
1	360	69	407
2	540	104	610
3	600	2,023	3,428
4	900	3,035	5,142
5	900	3,035	5,142

*Average water demands for Options 3-5 assume 75 percent plant capacity factor. This capacity factor is very conservative since typical capacity factors for simple cycle and combined cycle are less than 5 percent and 40 percent respectively. The groundwater withdrawals are expected to be far less than used in conducting this analysis.

Results of a numerical groundwater flow modeling analysis of potential drawdown impacts associated with groundwater use at TVA's adjoining Lagoon Creek generation facility are used to approximate worse-case groundwater impacts of plant options 4 and 5. A comprehensive description of the Lagoon Creek groundwater analysis is presented in Section 4.2.3 and Appendix H of the Lagoon Creek EIS (TVA, 2000). The model was used to simulate the local and regional drawdown effects of withdrawals from a Memphis Sand well-field on each of the principal regional aquifers, i.e., the Cockfield, Memphis Sand, and Fort Pillow aquifers. Drawdown effects for both long-term average demands and short-term peak use conditions were considered.

One of the plant design alternatives evaluated in the LC EIS involved a facility having 1000 MW of combined-cycle capacity and 700 MW of simple-cycle CT capacity. Facility water requirements for this alternative averaged 4304 gpm with peak demand of 5938 gpm, and are similar (in fact, somewhat higher) than those estimated for plant options 4 and 5 of this EA (see Table 3). Therefore, drawdown impacts predicted for this LC plant alternative should represent a conservative estimate of potential drawdown effects of options 4 and 5. The Lagoon Creek EIS analysis addressed both local and regional potentiometric declines in the Cockfield, Memphis Sand and Fort Pillow aquifers. The Lagoon Creek EIS analysis indicated small but widespread drawdown over a large part of western Tennessee. Within a radius of 2 miles of the plant site, moderate drawdowns of 10 to 20 feet were predicted in the Memphis Sand, 8 to 11 ft in the Cockfield aquifer, and less than 1 foot in the Fort Pillow aquifer. Declines of this magnitude would result in modest increases in pumping lifts and associated costs to local well users. Impairment of relatively shallow Cockfield wells with limited capacities or depth margins located in close proximity to a plant site is possible. These modest drawdowns are not expected to have a significant drawdown on the groundwater aquifers. However, in the event that neighboring wells in the vicinity are affected, TVA would compensate the well owner by either modifying their well by lowering the pump intake, installing a new well, or by providing a connection to public water supply, if available.

TVA will conduct additional technical evaluations in the future to determine whether the site is better suited for simple-cycle or combined-cycle operation. This evaluation will also take into account the demand for power in the near term. Simple-cycle operation would require much less ground water to be pumped because of the lower capacity factor and lack of a steam turbine and heat recovery steam generator (HRSG). A combined-cycle facility, by contrast, would use groundwater at a much higher rate. If, after future evaluations TVA decides to install a combined-cycle facility, this NEPA review may need to be further supplemented with the benefit of site-specific information then available. That evaluation will consider site specific design features for minimizing impacts to neighboring groundwater users, such as the potential for developing the plant well field partially or entirely in the deeper Fort Pillow aquifer. The inventory of public and private water supply wells in the site vicinity conducted for the LC EIS will be further updated in any such supplemental NEPA review. Likewise, the cumulative impacts analysis will also be further updated in any such review.
I

<u>Air Quality</u>

Affected Environment

Air quality is an environmental resource value that is considered important to most people. Through its passage of the Clean Air Act, Congress mandated the protection and enhancement of our nation's air quality resources. National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants have been set to protect the public health and welfare. These are sulfur dioxide (SO_2); ozone (O_3); nitrogen oxide (NO_2); particulate matter whose particles are less than or equal to (<=) 10 micrometers (PM_{10}); particulate matter whose particles are <= 2.5 micrometers ($PM_{2.5}$); carbon monoxide (CO) and lead (Pb).

Regionally the air quality is good. All areas in the vicinity of the site are currently in attainment for all criteria pollutant. The Prevention of Significant Deterioration (PSD) regulations have been established to ensure that areas with good air quality do not lose their attaniment status.

Environmental Consequences

Impacts to air quality could result from either: 1) the refurbishment and limited construction activities required to re-establish the Tenaska site as a combustion turbine facility, or 2) the operation of the facility.

Any of the alternatives under consideration could have associated transient and minor air pollution emissions in the form of fugitive dust particulate matter during the limited preparation, construction, and refurbishment activities at the site. Construction-related air impacts would primarily be related to operation of vehicular traffic. The majority of the impacts from land clearing and site preparation have already occurred during initial construction at the site. Most of any fugitive dust generated would be deposited within the site boundaries, with the remaining small fraction transported beyond the property boundary. As necessary, emissions from open construction areas and unpaved roads would be mitigated by spraying water on the surfaces.

During the refurbishment period, combustion of gasoline and diesel fuels by internal combustion engines would generate local emissions of PM, NOx, CO, volatile organic compounds (VOCs) and SO2. The total amount of these emissions would be small and would result in minimal, insignificant off-site impacts, well below any applicable ambient air quality standard.

None of the anticipated emissions from any of the configurations would be expected to have impacts that exceed NAAQS limits. Additionally, PSD requirements which would most likely be applicable to the establishment of a combined cycle facility are specifically designed to ensure that a new or modified facility does not have unacceptable air quality impacts. Air quality impacts from operation of the proposed facility would be maintained in accordance with PSD requirements, which ensure that direct, indirect, and cumulative impacts of emissions to air quality must be less than significant. A Simple-cycle facility would be operated in conjunction with the use of dry low NO_X combustion controls so that the New Source Performance Standards (NSPS) are met, and a combined-cycle facility would be operated with Selective Catalytic Reduction (SCR) controls to meet the Best Available Control Technology (BACT) requirements of PSD permitting.

In the Lagoon Creek EIS (Section 4.2.1) TVA estimated (as alternative 3 in that EIS)the air quality impacts of the operation of a facility producing 700 MW peaking power(using simple cycle turbines) and 1000 MW of baseload power (using combined cycle turbines) at the Lagoon Creek site. This assessment addressed the impacts of criteria pollutant emissions, air toxics, and cooling tower draft, concluding that there would be no adverse impacts on air quality, That analysis would apply to the establishment of a simple cycle or combined cycle facility at the Tenaska site which is in the close vicinity of the Lagoon Creek site. The analysis from the Lagoon Creek EIS is therefore incorporated by reference.

Surface Water Resources

This section evaluates the potential impacts of the proposed project on local surface water resources. The actual water discharges associated with the project operation will depend on the alternative selected. Due to the various alternatives, it has been decided to evaluate the worst-case discharge, which for the proposed alternatives is the combined-cycle plant, assuming 900 MW of capacity and a recirculating cooling system employing direct contact cooling towers. The surface water impacts of the simple-cycle units are minimal since the only significant wastewater discharges are the turbine washes and these are rare. In any of the alternatives, these wastewaters will be handled by collection and off-site processing.

Affected Environment

It has been previously determined that the available surface water in the vicinity of the Tenaska site is generally inadequate and or inappropriate to meet the water supply needs of a power plant. The water supply impacts evaluation in this assessment address only groundwater and are presented elsewhere in this assessment. This section presents an overview of the local surface waters and an assessment of the impacts of the proposed project on the surface waters of the state.

Lagoon Creek

The project site is located in the Lagoon Creek Watershed, which drains to the Hatchie River at the intersection of Haywood, Lauderdale, and Tipton Counties. Lagoon Creek has a drainage area of approximately 47.2 square miles at its mouth. An unnamed tributary of Lagoon Creek drains the Lagoon Creek Site. Lagoon Creek is an intermittent stream near the plant site, which means that the channel is often completely dry between rainfall events.

Hatchie River

The Hatchie River is approximately 10 miles from the site and has a drainage area of approximately 2210 square miles at its confluence with Lagoon Creek. In very dry years, the amount of water flowing in the river can and has actually dropped below the 3Q20 flow, usually in the summer and early fall. The Hatchie River has been designated as a state Scenic River and its presence on the State's 303d list of impaired streams makes it an unlikely candidate for wastewater discharges

IMPACTS OF CONSTRUCTION

The overall area to be disturbed by the project is relatively small, approximately 25 acres. Most of the construction impacts have been previously incurred as in this case the plant is existing and construction will be limited to upgrading the combustion turbine units and providing for installation of any new ancillary systems such as cooling towers. As a result, the impacts will be localized and much less invasive than a greenfield construction project. Construction would be expected to increase erosion and storm water runoff of suspended solids above current levels, but this would be mitigated by Best Management Practices (BMPs) in accordance with National Pollutant Discharge Elimination System (NPDES) guidelines for erosion control to result in minimal impacts. BMPs are defined in 40 CFR 122.2 (EPA 1998a) as "schedules of activities, prohibitions of practices, maintenance procedures and other management practices to prevent or reduce the pollution of waters of the United States." BMPs include "treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage." Typical BMPs and other details of erosion control measures are expected to be specified in a Storm water Pollution Prevention Plan (SWPPP) and governed by a construction storm water permit issued by the Tennessee Department of Environment and Conservation (TDEC) for this project. TDEC requires rigorous application of BMPs for erosion control during onsite construction to protect local watersheds.

Aquatic habitats could be impacted indirectly by erosion runoff from areas of exposed soil during construction. Other potential sources of indirect impact would be soil tracked onto roadways from the site and then washed into neighboring streams, leaks or spills of petroleum products from construction equipment, and wastewater originating from temporary sanitation and construction facilities. These impacts would be minimized through the development and implementation of the required construction Storm Water Pollution Prevention Plan discussed above. With these measures, TVA has determined that indirect impacts to aquatic habitats would be insignificant.

POST CONSTRUCTION AND OPERATING IMPACTS - 900-MW COMBINED-CYCLE PLANT

Cooling Water

For any alternative which involves the operation of combustion turbines in the combined-cycle mode (i.e., with heat recovery), an NPDES wastewater discharge permit would be required due to the discharge of heat in the blowdown from the cooling towers. For this reason, a detention/cooling pond for cooling water will be constructed onsite to minimize impacts on Lagoon Creek. Completion of the detention pond for the treatment of cooling water early in the construction phase will also significantly reduce potential increased solids loading from storm water runoff that originates from within the battery limits of the plant. This would allow site runoff to be managed effectively so that surface water runoff from parking lot and industrially used areas of the site are diverted to the detention pond(s) with a controlled rate(s) of release. Runoff from areas with potential oil leaks would be directed to an oil/water separator with subsequent discharge to the detention pond(s). Oil collected in the oil/water separator will be periodically removed and trucked offsite to an approved, waste oil recycling facility.

Process Wastewaters

The compressor wash-water stream, which is the major process wastewater stream would be collected and disposed offsite at an approved wastewater treatment facility. This activity will require a Standard Operating Permit under the NPDES program administered by the Tennessee Department of Environment and Conservation (TDEC). The compressors are washed approximately every 12 to 18 months and produce approximately 2,000 to 3,000 gallons of wash water per unit per year. Compressor wash water contains primarily oil and grease, suspended solids, and minor concentrations of metals. Based on TVA's experience, compressor wash water exhibits no hazardous properties and requires no special handling or pretreatment prior to shipment to an approved treatment facility.

With combined-cycle operation, the plant would include a steam boiler. The steam boiler would require a continuous demineralized water feed and water recovered in the condensers would require cooling. Thus, demineralized water and cooling tower blowdown would be added to the wastewater stream under the combined-cycle mode of operation.

Table 4 lists the wastewater streams and their expected flow rates for a typical 1,000 MW combined-cycle plant The annual range of wastewater discharge volumes for the worst case alternative was estimated by assuming that the maximum predicted flow would occur for the entire time the units would be operating, and on an annual basis, the service factor would range from 60 percent to 100 percent of the time (Parsons 1999). A percentage of once-through cooling water may also be discharged when ambient temperatures are excessively high. The maximum wastewater flow expected during summer operating conditions when high ambient temperatures increase cooling tower blowdown is about 1.5 cubic feet per second (cfs), unless ambient air temperatures are high enough to require the use of once-through cooling water, which would increase the flow to 1.9 cfs as discussed below. Metals and anions present in the well water used to supply the CT process can be expected to be concentrated by a factor of 10. Assuming that the site well water is similar in quality to the City of Brownsville's well water, the wastewater discharge is expected to have the characteristics listed in Table 5.

The expected quality and other characteristics of wastewater discharges for all three plant alternatives are discussed below. Preliminary estimates of wastewater discharge volumes are approximately 1 million gallons per day and 264.9×10^6 gallons per year (gal/yr), dependent mainly on the quantity of blowdown produced by the cooling towers (Parsons 1999).

Table 4. Wastewater Discharge for a 1000 MW Combined-Cycle Plant

Source	Maximum (gal/min)	Typical[a] ($\times 10^6$ gal/yr)
Demineralized water	17	2.5
Cooling Water	660[b]	260.6
Potable Water	NA	NA
Utility Water	30	1.8
Total	**707**	**264.9**

a - Assumes 90 percent service time
b - Assumes 20 percent of the makeup rate for blowdown and seven water cycles for the mechanical draft cooling towers

Table 5. Characteristics of Wastewater Expected from the Combined-Cycle Operation at 1000 MW of Capacity

Characteristic	Quantity
Flow	660 to 850 gpm
Temperature (Assuming Necessary Mitigation to Maintain Summer Effluent Discharge Temperature Limits as Required by Regulation)	0.04°C to 30.5°C
pH	7.5 to 8.0
Suspended Solids	50 mg/L
Dissolved Solids	550 mg/L
Phenolphthalein Alkalinity as Calcium Carbonate	50 mg/L
Methyl Orange Alkalinity as Calcium Carbonate	150 mg/L
Chloride	27 mg/L
Iron	0.62 mg/L
Sulfate	60 mg/L

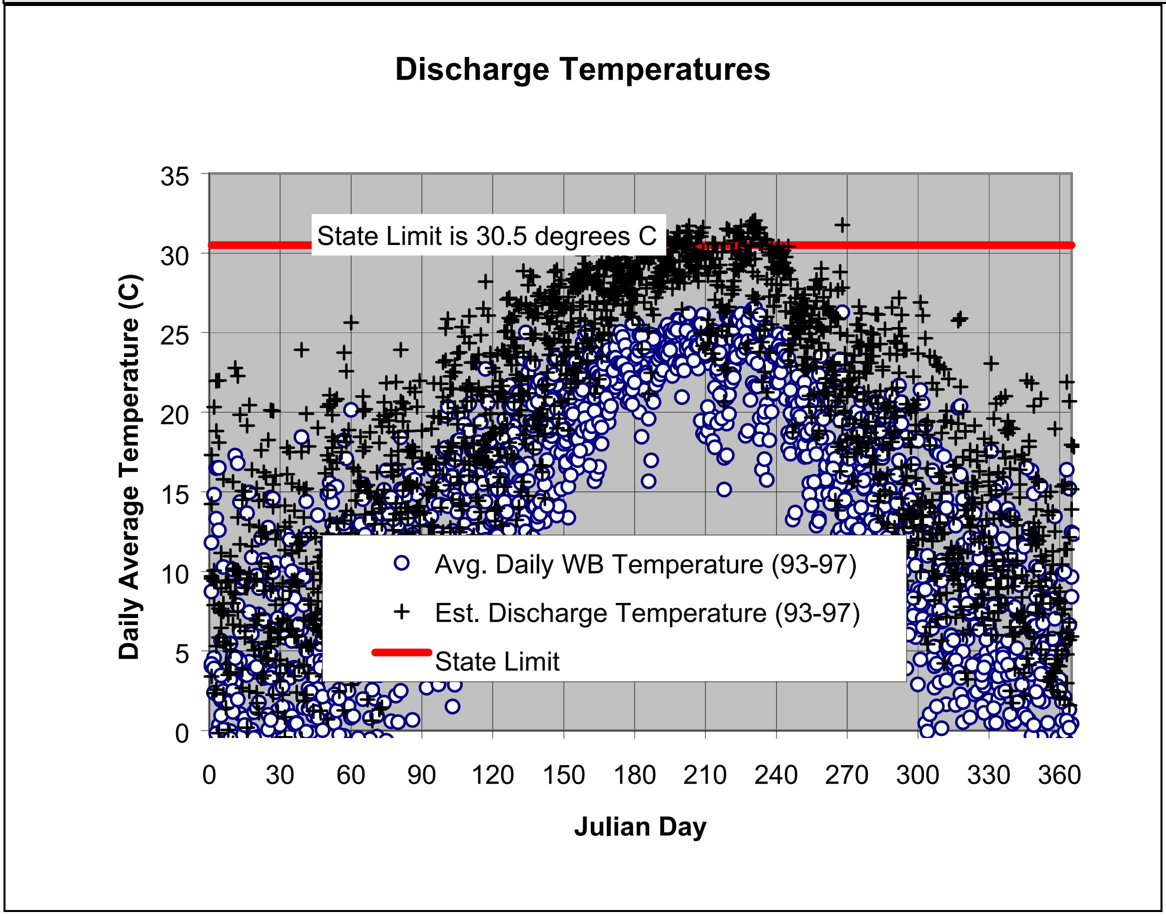
Wastewater would be piped to either a new detention pond or the existing pond at the TVA Lagoon Creek facility. Both receiving streams for the proposed Lagoon Creek combined-cycle wastewater discharge are intermittent streams. Since these streams could be expected to be at zero flow during the hottest months of the year, the discharge water would have to meet the State of Tennessee's Instream Water Quality Criteria at the point of discharge.

The characteristics given in Table 5 would meet state water quality criteria for the designated uses for Lagoon Creek. The projected 660 gpm of steady flow through the channels should not cause any erosion problems.

Temperature constraints may require some type of mitigation in addition to the proposed closed loop cooling towers. The state limit for thermal discharge temperatures is 30.5°C (86.9°F). The plant would utilize cooling towers in a closed loop system to provide cooling water for the steam turbines. The effectiveness of the cooling towers is a function of the ambient wet bulb temperatures in the area. Data received by TVA indicates cooling water blowdown temperatures would be at ambient wet bulb temperature plus 5.5°C (10°F) (Parsons 1999).

In Figure 2, the graph shows the daily average wet bulb temperature projected cooling water blowdown temperatures which are the wet bulb temperature plus 5.5°C (10°F), the state thermal discharge limit, and historical temperature data from streams in the area (USGS 1999). Note that during July and August, the estimated cooling tower effluent temperatures would exceed the state limit unless additional mitigation measures are employed. For the Memphis, Tennessee area, the average peak wet bulb temperature during July and August is 23.3°C (74°F) with peak wet bulb temperatures reaching near 26.6°C (80°F). With the state thermal discharge limit of 30.5°C, anytime the wet bulb temperatures approach 25°C, the resulting blowdown temperatures would exceed the state limit. To eliminate the potential violation of the state discharge temperature limit, additional steps would be required to reduce the discharge water temperature. Various approaches to mitigate this problem are described below.

Figure 2 Peaking Discharge Temperatures



Groundwater for Thermal Mitigation

One method that could be utilized to reduce the discharge temperature would be to mix groundwater with the releases. Groundwater temperatures in the area are typically around 20°C (Memphis sand test well data 1999). Assuming the blowdown temperature is 32.1°C (26.6°C ambient wet bulb plus 5.5°C) and the blowdown flow is 660 gpm, the necessary additional groundwater discharge would be about 190 gallons per minute (gpm) in order to lower the water temperature at least 1 degree below the 30.5°C limit. The worse-case total groundwater usage could be estimated based on 50 days, 12-hour per day usage, or a total of approximately 4.5 million gallons per year. Average usage of groundwater for this alternative would likely be two million gallons per year based on 1993 data.

Retain Wastewater to Discharge at Night

A second alternative available to reduce the discharge temperature would be to hold the water in a holding pond during the hotter daylight hours and discharge the water through a cooling tower during the cooler hours at night. Thus, cooling tower operations would have a greater impact on discharge water temperatures. Night time wet bulb temperatures are typically 1°C to 2°C (2°F to 4°F) lower and would reduce the estimated peak blowdown discharge temperatures by the same amount (National Weather Service). This would also reduce the quantity of additional groundwater needed for temperature dilution to approximately 400,000 to 500,000 gallons per year (1993 data).

ADDITIONAL COOLING TOWER

A third alternative would be the installation of an additional cooling tower just for the cooling tower blowdown discharges. Smaller towers are capable of achieving approach temperatures to wet bulb of 5°C, (2.8°F) (Cooling Tower Institute 1999). This would lower the proposed combined-cycle plant discharges to below the state limit and would allow for 24-hour per day discharges according to 1996 and 1997 data (National Weather Service). Peak discharge temperatures would reach 29.5°C when the additional cooling tower is in use.

Storm Water

Post-construction storm water impacts, such as introduction of contaminants through contact with rainfall, would be minimized through the implementation of a Storm Water Management Plan and governed by a Tennessee Multi-sector General Permit for the facility. This would include good housekeeping practices for storage and use of materials that could cause pollution, as well as engineering controls that aid in the removal of contaminants and sediments from surface runoff before it enters the receiving stream. These engineering controls would include routine measures such as detention ponds, grassed swales, or catch basins with oil/grease separators. With the implementation of these measures, TVA has determined that post-construction impacts to aquatic habitats would be insignificant.

All of the possible receiving streams in the vicinity of the site are wet weather conveyances (i.e., intermittent streams). As previously discussed, the Lagoon Creek Site is located in the watershed drained by the Hatchie River, a river afforded special protection by Tennessee regulations by virtue of its designation as a Scenic River.

Sanitary Wastewaters

All sanitary waste from the site will be sent to a waste absorption field located onsite. A septic tank and drain field have been installed and designed to accommodate the site soil conditions and utilized for the treatment of the sewage generated from a workforce of about 20 to 25 people.

NOISE

Affected Environment

The area surrounding the Tenaska site is rural with a low density population density. There are active crop farming and livestock operations close by, and there is no concentrated residential development. State Highway 19 generally runs southeast/northwest about a mile and a quarter to the northeast at is closes point. Several other county roads service the area between the site and Highway 19. There are residences to the north, northeast, and east of the site with closest residence about 4950 feet from the site boundary in the northeast direction. It is not a pristine area where the lack of man made noise is considered an asset.

Traffic and seasonal agricultural activity are the primary community noise sources in the area. Localized, residential noise from air conditioning is also significant during the warm part of the year.

Ambient Noise

After the completion of the adjacent original Lagoon Creek combustion turbine (CT) plant, TVA conducted an environmental noise survey in accordance with the commitment in the Record of Decision for the Lagoon Creek EIS. The four measurement locations for this survey were adjacent to the closest residential receptor. The ambient environmental noise level (total of the current CT plant noise and the community generated noise) is presented as the equivalent sound level day/night ($L_{d/n}$). The $L_{d/n}$ is the equivalent sound energy for 24 hours with a 10 dBA penalty added to the intruding plant noise between 11:00 p.m. and 7:00 a.m. The present ambient $L_{d/n}$ ranges from about 43 dBA in the summer with all 12 CTs operating on natural gas to about 50 dBA in the winter with all of the CTs burning oil.

Environmental Consequences

Intruding Noise Impacts

The potential impacts from intruding noise usually include sleep disturbance and general annoyance. Each of these is highly subjective based on the noise receptor's sensitivity and perspective. For example, a person who dislikes industrial development could consider any intruding noise from a plant as very significant; where as a plant employee or family member could judge the same noise level to be insignificant because of the employment value.

Typical noise design criterion for the installation of heating and air-conditioning system are in the 35 to 38 dBA range for sleeping rooms to prevent sleep disturbance (Beranek 1992). The Environmental Protection Agency (EPA) has a former guideline to limit indoor $L_{d/n}$ to 45 dBA to prevent disturbance of indoor activities (EPA 1974). (Note – EPA no longer issues environmental noise guidance.) Also, the EPA has a former guideline to limit outdoor noise to 55 dBA in rural areas to prevent disturbance of outdoor activities (EPA 1974).

The Department of Housing and Urban Development (HUD) has guidelines for placing HUD residential development. These guidelines are 65 dBA daytime and 55 dBA nighttime and are intruding noise levels not $L_{d/n}$ as EPA uses.

Intruding Noise

The total noise emitted from the Tenaska plant can be calculated by adding the noise emissions from the major pieces of equipment. Because the equipment dimensions are much smaller than the distance to the residential receptors, the plant can be considered a noise point source for calculating the intruding noise level at the receptors. The major pieces of equipment noise emissions levels are given below.

Table 6. Noise Emissions

Plant Equipment	Noise Emissions @ 400 feet, dBA	Source of Noise Emission Data
Mitsubishi M501F CT	44 dBA each 49 dBA for 3 CTs	E-mail from Mitsubishi Power Systems

	Stable operations	
Heat Recovery Steam Generator	63 dBA Stable operations	E-mail from Alstom Power (Franklin Co. CC03 proj.)
Toshiba steam turbine	71 dBA without building 51 dBA with building	Calculated based on MW, Harris 1991
Cooling tower 10 cells @ 100 hp/fan	73 dBA without low noise fans and controls 61 dBA with low noise fans and controls	Calculated based on hp, Beranek 1992

The calculated noise emissions from reference books could be high in comparison to today's technology. For example on a previous environmental noise investigation another vendor, General Electric, provided noise emissions data for some similar equipment; its steam turbine having a 47 dBA level at 400 feet with an enclosing building and a 10 cell cooling tower having a 41 dBA level at 400 feet.

The nearest residential receptor to the Tenaska plant is about 4950 feet to the northeast. The calculated, total intruding noise levels at this location are 54 dBA for equipment without the noise controls and 44 dBA with the noise controls. If the General Electric information is substituted for the noise control calculation the total intruding noise becomes 41 dBA. In order, to achieve EPA guidelines TVA will use, at a minimum, standard noise control techniques in the construction and operation of the Tenaska plant such as enclosing of the steam turbine and generator or using low noise fans.

The total intruding noise (44 dBA) from theTenaska plant using standard noise controls produces a 24 hour $L_{d/n}$ of 50 dBA, including the 10 dBA penalty for generation between 10:00 p.m. and 7:00 a.m. If more enhanced noise controls (41 dBA) are used the $L_{d/n}$ could drop to 47 dBA. Both of these levels are calculated at the nearest residential receptor about 4950 feet away.

The current $L_{d/n}$ at this same receptor site from the worst case operations of the original Lagoon Creek CT plant is 50 dBA. This worst case is 12 CTs burning oil in the winter time. Combining the intruding $L_{d/n}$'s from both sources produces a $L_{d/n}$'s of 53 dBA at the nearest receptor for the Tenaska site $L_{d/n}$ of 44 dBA and 50 dBA for the Tenaska plant$L_{d/n}$ of 41 dBA. These are below the EPA guideline of 55 dBA $L_{d/n}$ for rural areas.

This combined intruding noise level also is lower than the HUD guidelines for both daytime and nighttime.

A typically built frame house has a noise reduction capability of 20 to 25 dBA (EPA 1974). By subtracting this noise reduction from the total intruding $L_{d/n}$ the results are also less than the EPA guideline for indoors of 45 dBA. It is also below the generally accepted level for sleeping rooms.

The operation of the Tenaska plant should have an insignificant environmental noise impact on the residential receptors in the plant area.

CUMULATIVE IMPACTS

Potential cumulative impacts could be associated with air and water. Noise impacts are generally not cumulative in nature; an area that is already experiencing high noise levels actually would be less disrupted by another noise source than an area not experiencing such impacts. The air and water (PSD and NPDES) permit processes ensure that the cumulative impacts on air and water quality are not significant. The conditions established by emissions and discharges from a plant ensure that resulting impacts are environmentally acceptable even when added to the cumulated impact baseline. These permitting processes would also ensure that the existing plant's emissions and discharges are taken into account when any new facilities with emissions or discharges impacting the same air or watersheds are proposed. The cumulative noise impacts of the turbine operation at the Tenaska site after taking into account the existing noise impacts from Lagoon Creek site were found to be insignificant.

PREFERRED ALTERNATIVE

TVA is looking to better manage power supply needs, prudently hedge its exposure to power market risks, and meet new NERC requirements. Technological advances during the 1990s produced significant improvements in the economic and operational efficiencies of CT/CC plants and reduced the environmental impacts associated with their operation. TVA's Energy Vision 2020 EIS process identified CT/CC plants as acceptable generation options. The environmental footprint of operating a CT/CC plant is very small, and applicable environmental permitting processes further ensure that operational effects would be insignificant. Accordingly, TVA's preferred alternative is to purchase this existing CT/CC plant site and combustion turbines from other sites in order to assist in meeting the peaking and intermediate capacity needs.

SUMMARY OF ENVIRONMENTAL COMMITMENTS

- In the event that neighboring wells in the vicinity are affected, TVA would compensate the well owner by either modifying their well by lowering the pump intake, installing a new well, or by providing a connection to public water supply, if available.

- If after future evaluations TVA decides to install a combined-cycle facility at the Tenaska site, TVA will re-evaluate this EA to determine whether or not the environmental analysis needs to supplemented.

- Wastewater would be piped to either a new detention pond or the existing pond at the TVA Lagoon Creek facility.

- The compressor wash-water stream, which is the major process wastewater stream would be collected and disposed offsite at an approved wastewater treatment facility.

- The plant would utilize cooling towers in a closed loop system to provide cooling water for the steam turbines. To meet the state discharge temperature limit, additional steps would be taken as necessary. . These additional steps could include the use of ground water for thermal mitigation, retention of waste water for discharge at night, or the installation of an additional cooling tower.

- TVA will use, at a minimum, standard noise control techniques in the construction and operation of the Tenaska plant such that EPA Noise Guidelines are meet.

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AGENCIES AND OTHERS CONSULTED

List persons, agencies, and organizations consulted.

REFERENCES

Beranek, L. L., and I. L Vér, editors, Noise and Vibration Control Engineering Principles and Applications, John Wiley & Sons, Inc., New York, 1992.

Energy Vision 2020 Integrated Resource Plan Final Environmental Impact Statement (EIS), TVA (1995)

Generic Environmental Assessment (EA) for the Purchase of Additional Combustion Turbine Capacity, TVA, September 2006

Harris, C. M., editor, Handbook of Acoustic Measurement and Noise Control, 3rd Edition, McGraw-Hill, Inc., New York, 1991.

"Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety," EPA Report No. 550/9-74-004, U.S. Environmental Protection Agency, Washington, D.C., March 1974.

TVA Lagoon Creek Final Environmental Impact Statement, TVA, March 2000

Rural Utility Service; Programmatic Environmental Assessment for Front End Financing for Combustion Turbine Purchased by Generation and Transmission Borrowers, December 2000.